Monitoring Sand and Dust Storms from Space

for Expert Consultation on Disaster Information and Knowledge, Session 2

WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

ICC-21 for ESCAP's RESAP and CDRR-5
9-12 October, 2017

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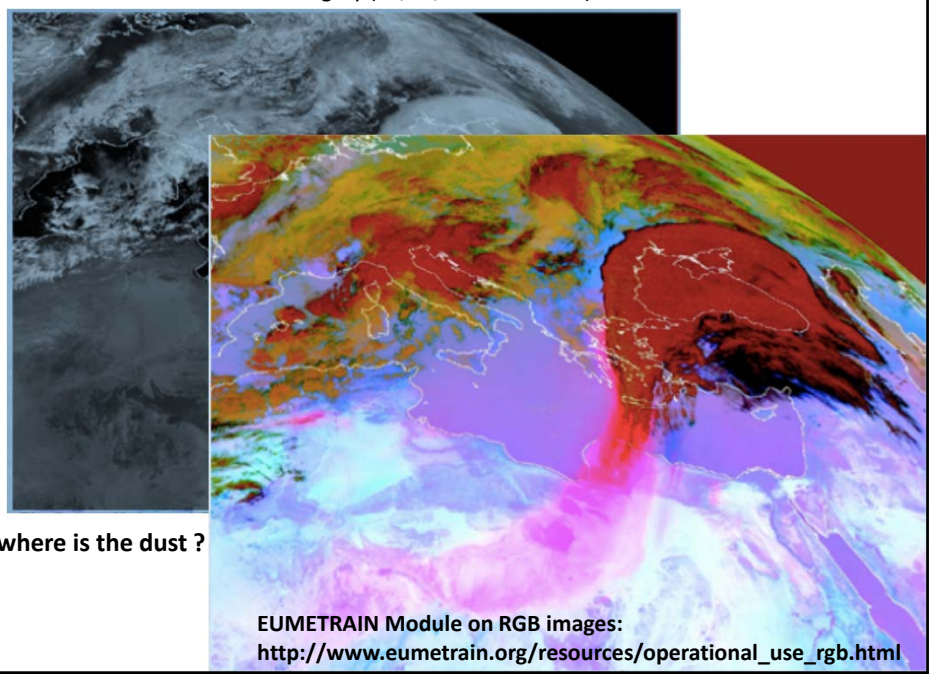
WMO Space Programme Office

Space-based Qualitative Monitoring of Sand and Dust Storms

EUMETSAT RGB Imagery Recipe

for extracting meteorological parameters from VIS/IR Multi spectral imager onboard Meteosat Second Generation (MSG) series geostationary meteorological satellites

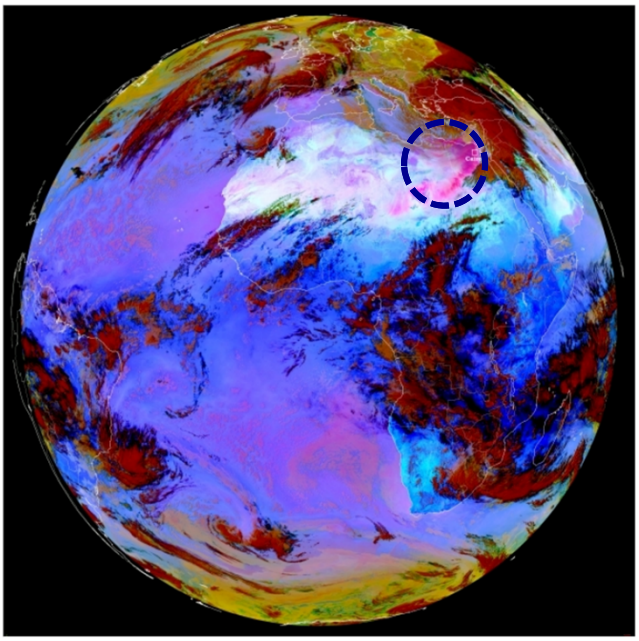
EUMETSAT MSG Visible 0.6 imagery (23/03/2008 – 12 UTC)



where is the dust ?

EUMETRAIN Module on RGB images:
http://www.eumetrain.org/resources/operational_use_rgb.html

EUMETSAT DUST RGB Imagery



Applications
Dust, Thin Clouds, Contrails
Area
Full MSG Viewing Area
Time
Day and Night (every 15 minutes)

Composition Recipe
Red: IR12.0µm – IR10.8µm
Green: IR10.8µm – IR8.7µm
Blue: IR10.8µm
Based on the principle of reverse absorption for dust with the IR10.8µm and IR12.0µm channels, as well as the differences in desert emissivity between IR10.8µm and IR8.7µm.

MSG-1
22 January 2004
12:00 UTC

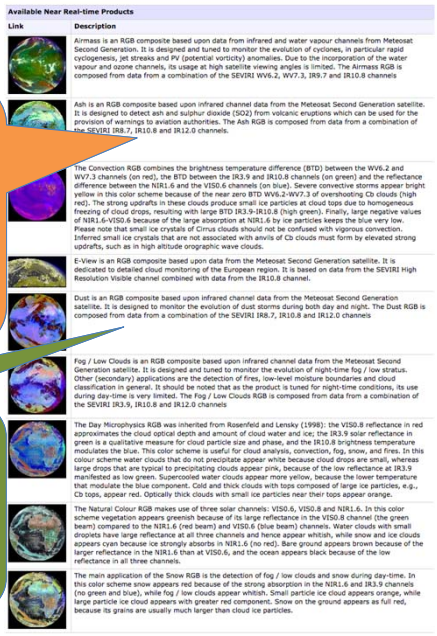
http://oiswww.eumetsat.int/~idds/html/doc/dust_interpretation.pdf

EUMETSAT RGB Compositing of Multi-Spectral Imagery

Ash is an RGB composite is designed to detect ash and sulphur dioxide (SO2) from volcanic eruptions which can be used for the provision of warnings to aviation authorities. The Ash RGB is composed from data from a combination of the SEVIRI IR8.7µm, IR10.8µm and IR12.0µm channels.

The advent of true multi-spectral im

Dust is an RGB composite is designed to monitor the evolution of dust storms during both day and night. The Dust RGB is composed from data from a combination of the SEVIRI IR8.7µm, IR10.8µm and IR12.0µm channels



http://oiswww.eumetsat.org/IPPS/html/MSG/RGB/

Comparison of onboard Imagers Specification, MSG and Himawari-8/9

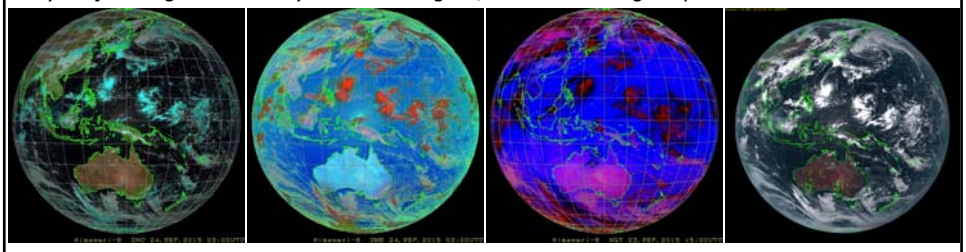
Channel	Himawari-8/ -9	MTSAT-1R/-2	MSG	Physical Properties	
1	0.46 μm			vegetation, aerosol B	Visible
2	0.51 μm			vegetation, aerosol G	
3	0.64 μm	0.68 μm	0.635 μm	low cloud, fog R	
4	0.86 μm		0.81 μm	vegetation, aerosol	Near Infrared
5	1.6 μm		1.64 μm	cloud phase	
6	2.3 μm			particle size	
7	3.9 μm	3.7 μm	3.92 μm	low cloud, fog, forest fire	Infrared
8	6.2 μm	6.8 μm	6.25 μm	mid- and upper level moisture	
9	6.9 μm			mid- level moisture	
10	7.3 μm		7.35 μm	mid- and lower level moisture	
11	8.6 μm		8.70 μm	cloud phase, SO2	
12	9.6 μm		9.66 μm	ozone content	
13	10.4 μm	10.8 μm	10.8 μm	cloud imagery, information of cloud top	
14	11.2 μm			cloud imagery, sea surface temperature	
15	12.4 μm	12.0 μm	12.0 μm	cloud imagery, sea surface temperature	
16	13.3 μm		13.4 μm	cloud top height	

Himawari RGBs

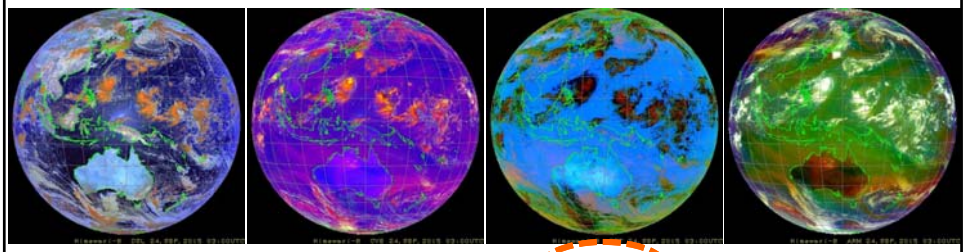
- Increased information by Himawari-8/AHI's 16 channels (multi bands) imagery
- EUMETSAT RGB recipes are applicable to Himawari-8 imagery.
- Applying EUMETSAT RGB recipes to Himawari-8
  - Localizing original EUMETSAT RGB recipes for detecting local phenomena in East Asia and Western Pacific regions
  - Developing new RGB products using newly added wavelength bands (0.47, 0.51, 2.3, 6.9μm) for Himawari-8

RGBs from Himawari-8

Very useful imageries to analyze meteorological/non-meteorological phenomenon

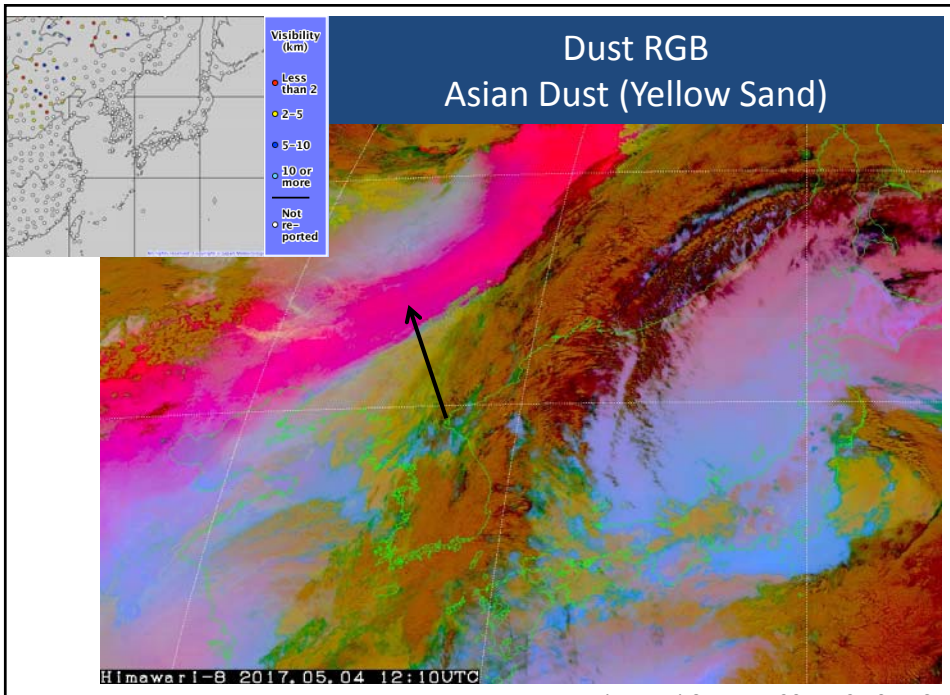


Natural Color | Day Microphysics | Night Microphysics | True Color



Day Snow-Fog | Day Convective Storm | Dust | Airmass

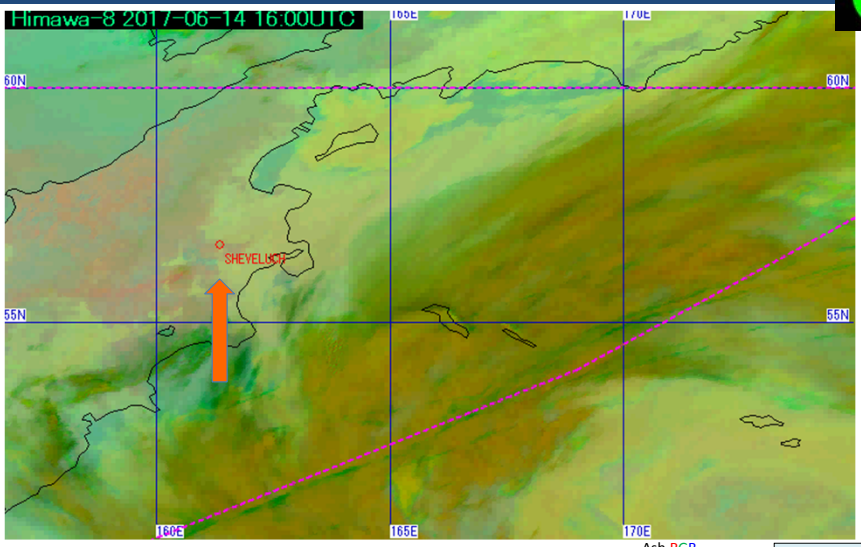
http://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php?area=fd_



Dust RGB
Asian Dust (Yellow Sand)

Himawari-8 May. 4 2017 12:10 UTC

Ash RGB Imagery

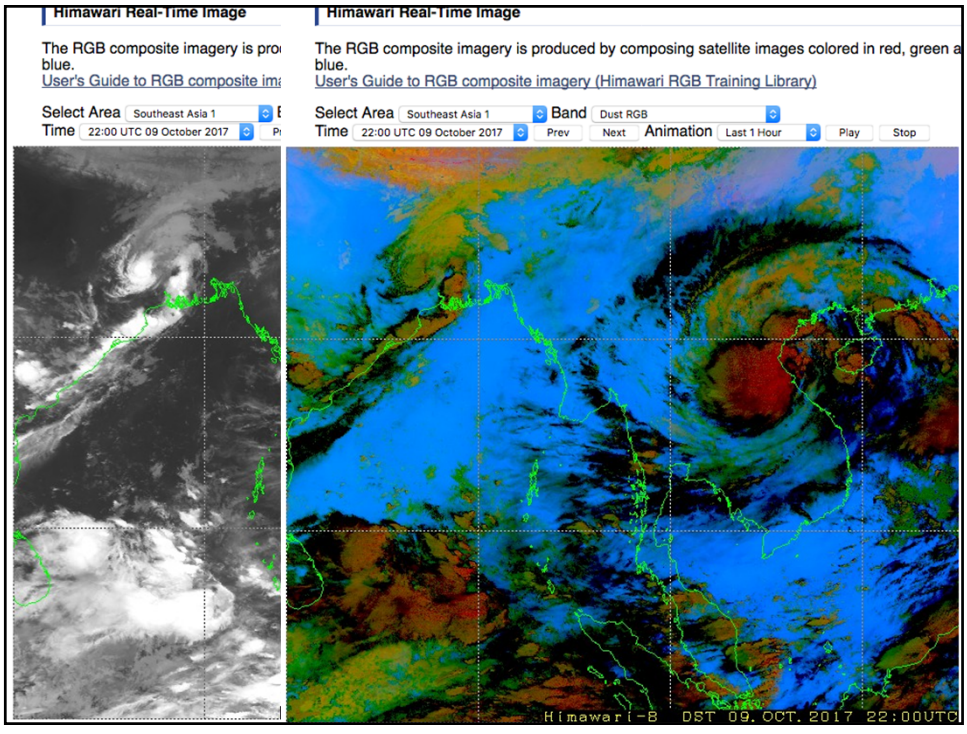


Sheveluch (56.65N 161.37E)
2017/06/14 1600～2017/06/16 0300（UTC）
Height of ash: 40,000feet（12,000m）

Ash RGB
R:12.4μm-10.4μm
G:10.4μm-8.6μm
B:10.4μm

R: Ash
G: SO2 gas
B: Height of ash

(Courtesy of Toshiyuki SAKURAI , Tokyo VAAC)



RGB Experts and Developers Workshop 2017
Hosted by JMA, EUMETSAT, and WMO
7 - 9 November 2017
JMA Headquarters, Tokyo, Japan

Workshop Objectives:
1. Review of existing RGB composite standards
2. Application of RGBs using new-generation imagers
3. Demonstrating the value of RGBs in context (NWP, products)
4. Compilation of demonstration and training material
5. Exploring new standards for satellite-based composites

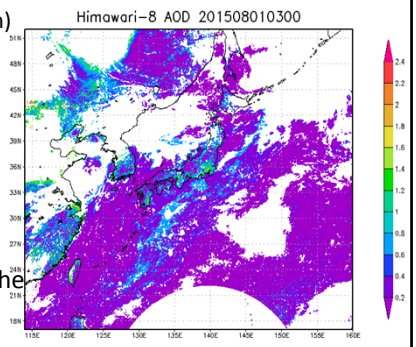
All documents and presentation will be available;
http://www.wmo.int/pages/prog/sat/meetings/RGB-WS-2017.php

Space-based Quantitative Monitoring of Sand and Dust Storms

for the Assimilation into a global aerosol transport model coupled with global circulation model (GCM)

Aerosol Optical Depth product (Himawari Asian Dust)

- **Aerosol Optical Depth and Angstrom Exponent**
  (Angstrom Exponent is derived only over the ocean)
- **Retrieval algorithm: LUT**
  - ✓ 0.64, 0.86 μm (ocean), 0.64, 2.3 μm (land)
  - ✓ Aerosol type is assumed to be Asian dust
  - ✓ NOT optimized for other aerosol types (e.g. haze)
- **Internal use (Asian dust monitoring)**
  - Plan for introducing a JAXA algorithm in the AOD product on February 2018
- **AHI aerosol products for data assimilation**
  - ✓ Under development in collaboration with JAXA
- **Volcanic ash retrieval algorithm would be applied to retrieve aerosol during nighttime**

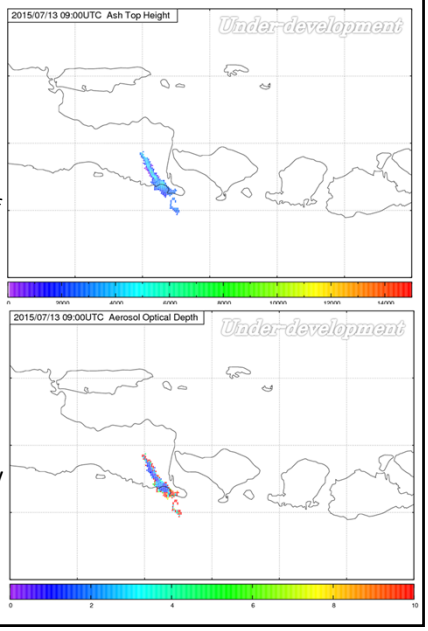


(Courtesy of D. Uesawa, JMA)

Volcanic Ash (Under-development)

- **Installation of NOAA/NESDIS Algorithm**
  - ✓ Under implementation VOLCAT software developed by NOAA/NESDIS for **Himawari-8 volcanic ash product** at JMA/MSC

  - Courtesy of NOAA, Dr. Pavolonis and Dr. Sieglaff
- **Expected Products**
  - ✓ Ash top height
  - ✓ Mass-loading
  - ✓ Optical depth
- **Evaluation and Validation**
  - ✓ Preliminary products will be provided to JMA's Tokyo VAAC (Volcanic Ash Advisory Center) for testing



Preliminary results of VOLCAT for the eruption of Raung (Indonesia) on 13 July 2015.

Responsibility of Tokyo VAAC

Duty for the area of responsibility

- collecting information on eruption/volcanic activity
- monitoring volcanic ash from satellite imagery
- forecasting ash extent
- issuing Volcanic Ash Advisories (VAAs)

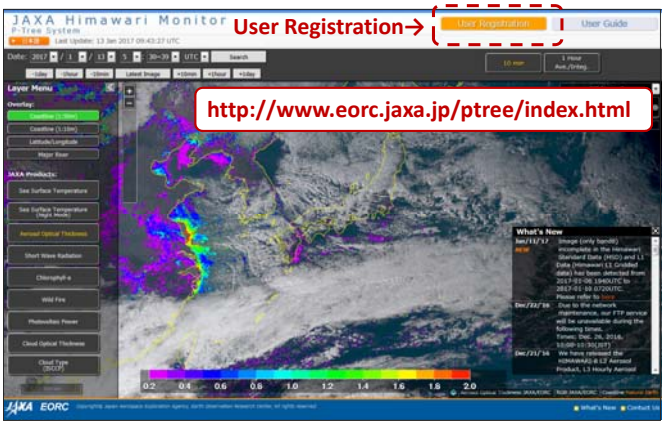
(Courtesy of Tokyo VAAC, JMA)

Collaboration between Meteorological Satellite Operator and Space Agencies

JAXA Himawari Monitor

- JAXA has been developing Himawari-8 products using the retrieval algorithms which will be consistent with the upcoming Japanese earth observation missions (GCOM-C, GOSAT-2 and EarthCARE), in order to seek synergies between the satellites
- JAXA Himawari Monitor website site was opened in August 2015 to distribute Himawari original (Level 1) and geophysical (Level 2) products

- Over 500 registrations from domestic and international users until today



Courtesy of Maki Kikuchi, JAXA

Aerosol Optical Thickness (1530UTC 13 Jan 2017 Ver. Beta)

JAXA Himawari Products

	Product name		Grid size	Interval	Format
L1	Reflectance (6 bands) Brightness temperature (10 bands)		500m/1km/2km	10min(full) 2.5min(Japan)	HSD NetCDF
L2	Atmos-phere	Aerosol properties	5km	10min/1hr	NetCDF
		Cloud properties	5km	10min	
	Ocean	Sea surface temperature	2km	10min/1hr/1dy	
		Ocean color (Chlorophyll-a)	5km(full) 1km(Japan)	1hr	
	Land	Wild fire	2km	10min	CSV
	Flux	Photosynthetically active radiation (PAR) & Shortwave radiation (SWR)	5km(full) 1km(Japan)	1hr	NetCDF
		Photovoltaic Power (image only)	1km/4km	10min	-

- Retrieval Algorithms are based on those developed for JAXA Earth Observation Satellite Projects. References are available at the web site. (http://www.eorc.jaxa.jp/ptree)

Courtesy of Maki Kikuchi, JAXA

Courtesy of Maki Kikuchi, JAXA

Tuesday, Nov 01 2016 All Cities Choose Your City

The Siberian Times

Home News Features Business City Focus Sport Culture Science Health & Lifestyle Ecology

Case study Opinion Profile

Siberia's wildfires seen from 1 million miles away: even the tundra is burning

By The Siberian Times reporter

23 July 2016

The Siberian Times, 23 June 2016

The Washington Post

Europe

Russian volunteers seek a foothold as wildfires rage in Siberia

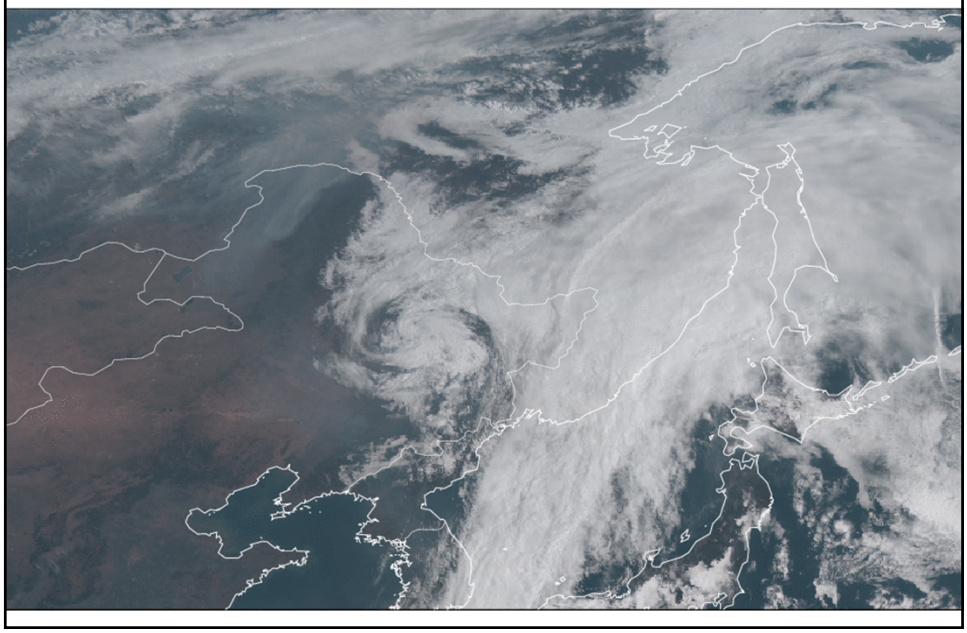
By Andrew Roth

The Washington Post, 25 June 2016

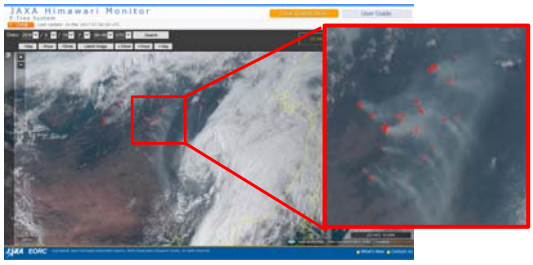
NC_H08_20160516_0000_R21_FLDK.02401_02401.nc

Courtesy of Maki Kikuchi, JAXA

Himawari-8 True Color Imagery (16-19 May 2016)



Himawari-8 Wild Fire Product



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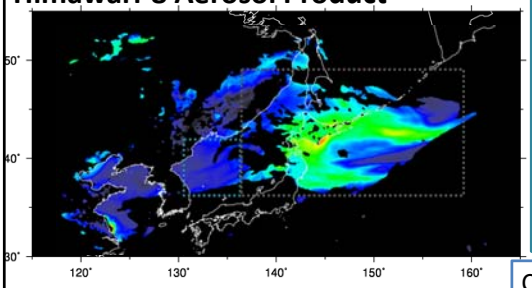
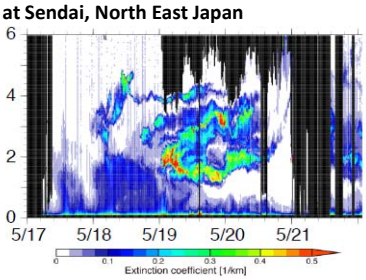
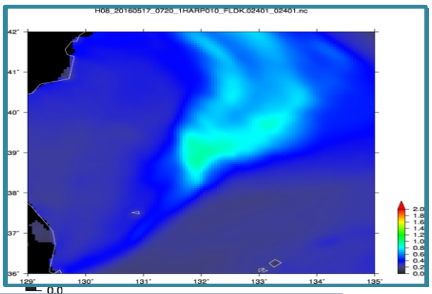
Himawari-8 Aerosol Product



Lidar Observation at Sendai, North East Japan

Courtesy to Dr. Yumimoto of MRI





Courtesy of Maki Kikuchi, JAXA

WMO opens new Regional Office in Singapore August 21, 2017

The World Meteorological Organization (WMO) has opened a new office for the Asia-Pacific region in Singapore to improve coordination on hazards ranging from floods to fires and to strengthen meteorological services for rapidly evolving economic sectors such as air and marine transport. The Regional Office is being hosted by the Meteorological Service Singapore (MSS) and will serve as the “nerve” centre for WMO’s programmes in the region.

Thank you

WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

Questions:
tkurino@wmo.int